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Adaptation of ground-water sampling tools for underwater deployment

Rob Pedersen,

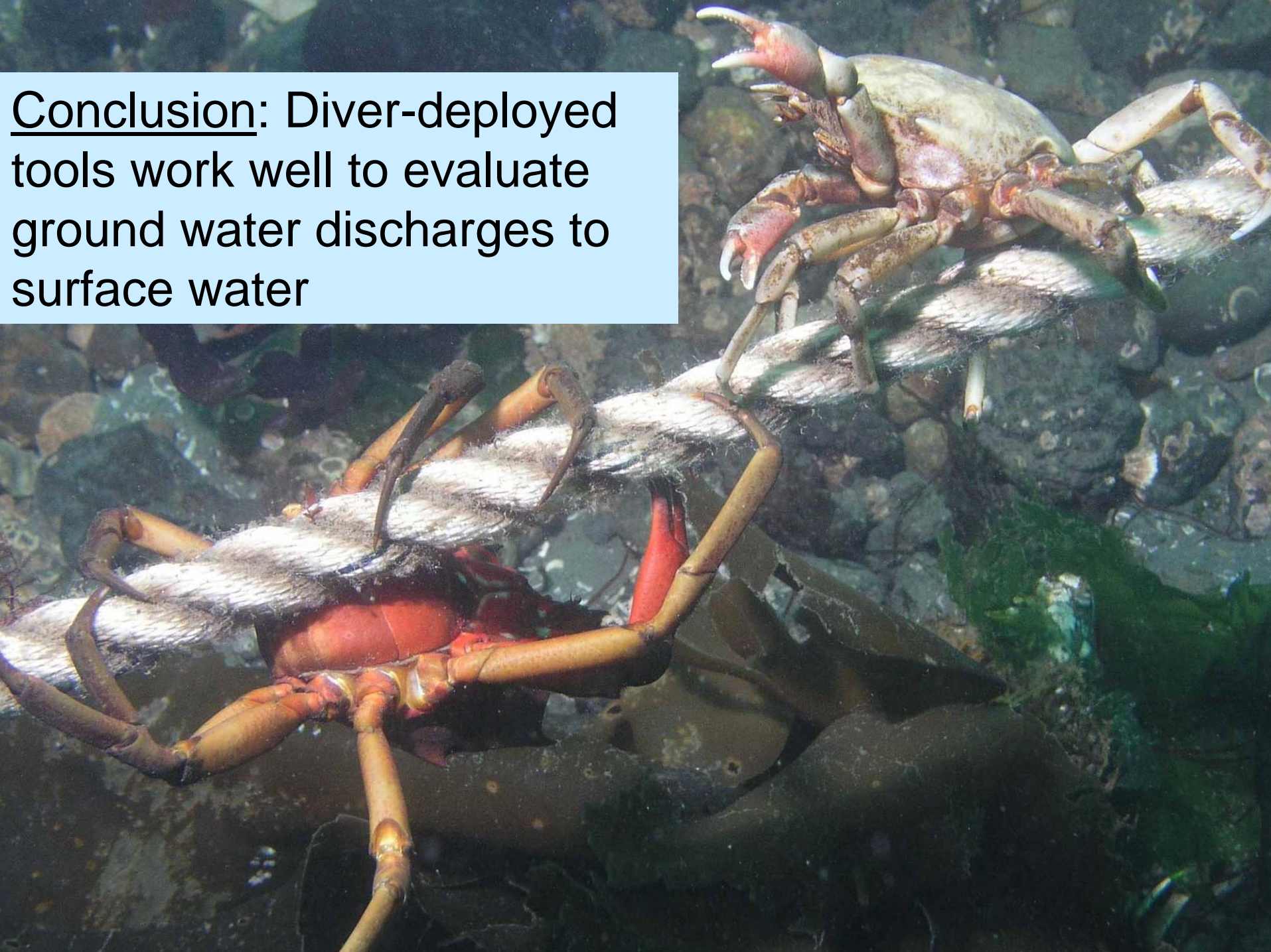
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U.S. EPA, Region 10 - Dive Operations Team



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ABSTRACT: The EPA-Region 10 (Seattle) Dive Team has adapted ground-water sampling tools for use underwater to collect ground-water/surface-water transition-zone information for risk assessments and/or cleanup decisions. The tools, which include various minipiezometers, seepage meters, and diffusion samplers, have been deployed in a variety of ecosystems (estuarine tidal rivers, bays, etc.) in depths from the shallow subtidal to over 10m water depth. This paper illustrates how divers use the tools by describing the methods and results from several case studies evaluating contaminated ground water in industrial waterways in Puget Sound. Although divers can conduct surveys for visual evidence of active or past seeps, poor visibility can negate the effectiveness of this approach. Therefore, a next step is often to use minipiezometers to obtain ground-water samples. Minipiezometers can be more effectively placed by first using a probe to determine the sediment type, ease of minipiezometer insertion, and thickness of any fine cohesive sediment layer that could prevent successful collection of a sample. Some minipiezometers are placed by pounding in a steel pipe, threading the piezometer, removing the pipe and leaving the piezometer in place. Others are simply pushed in and then tubing is attached and routed to the surface. Seepage meters used are five gallon buckets trimmed in size, with bags attached to collect discharging ground water. Diffusion samplers used are glass vials filled with distilled water and sealed with polyethylene membranes. These can be placed by hand to the desired depth (generally up to one "standard diver arm length").

Conclusion: Diver-deployed tools work well to evaluate ground water discharges to surface water



EPA's Goal when investigating contaminated sites:

How are organisms being exposed to contaminated GW?
And, what are the concentrations?



*Creosote oozing
from sediment*

EPA's Goal when investigating contaminated sites:

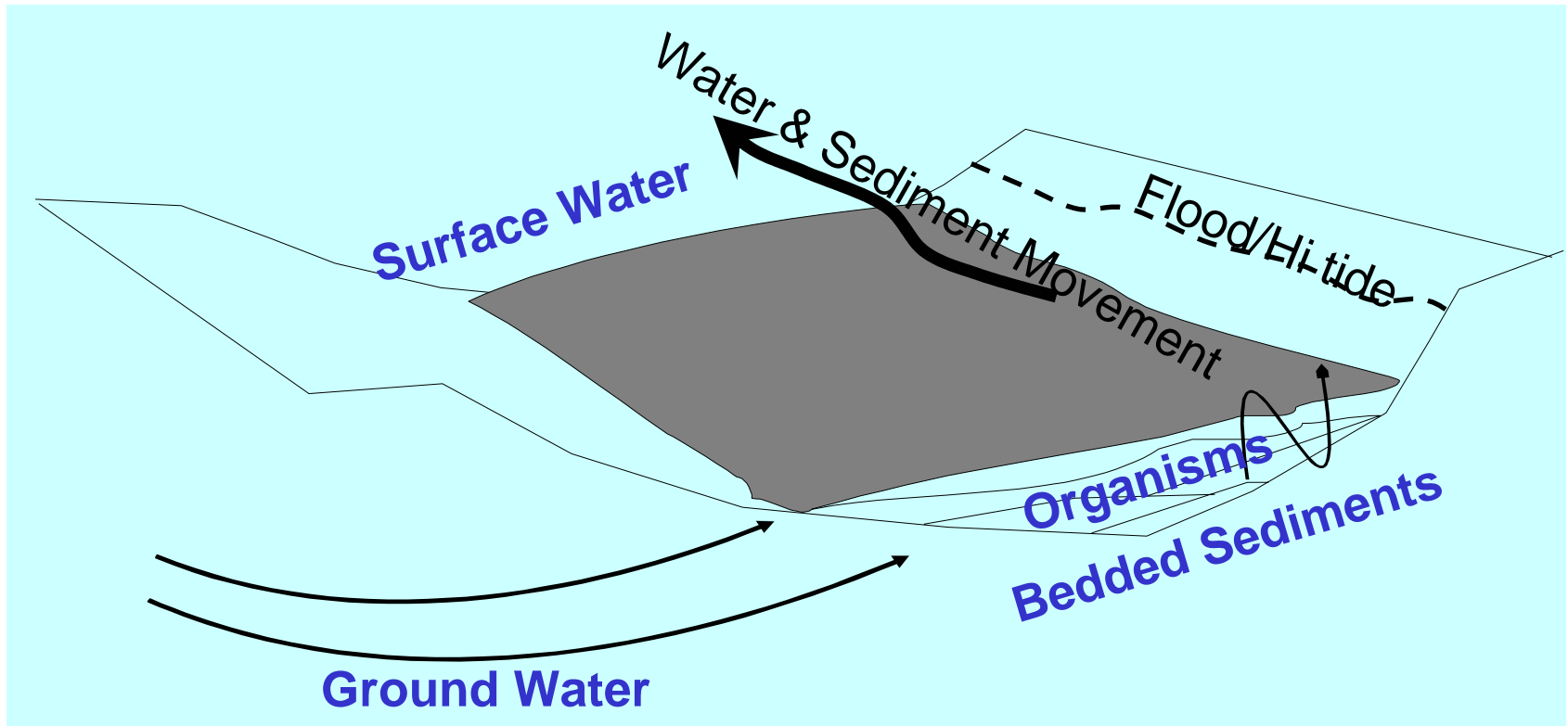
How are organisms being exposed to contaminated GW?
And, what are the concentrations?



*Divers and Sediments:
what about GW?*

Dynamic conceptual model:

Ground Water/Sediment/Surface Water/Organisms



Duncan et al. 2002 SETAC poster P384

Methods & Results

Tools:

minipiezometers

seepage meters

diffusion samplers

Minipiezometers



Mini-piezometers

Nest

Multilevel

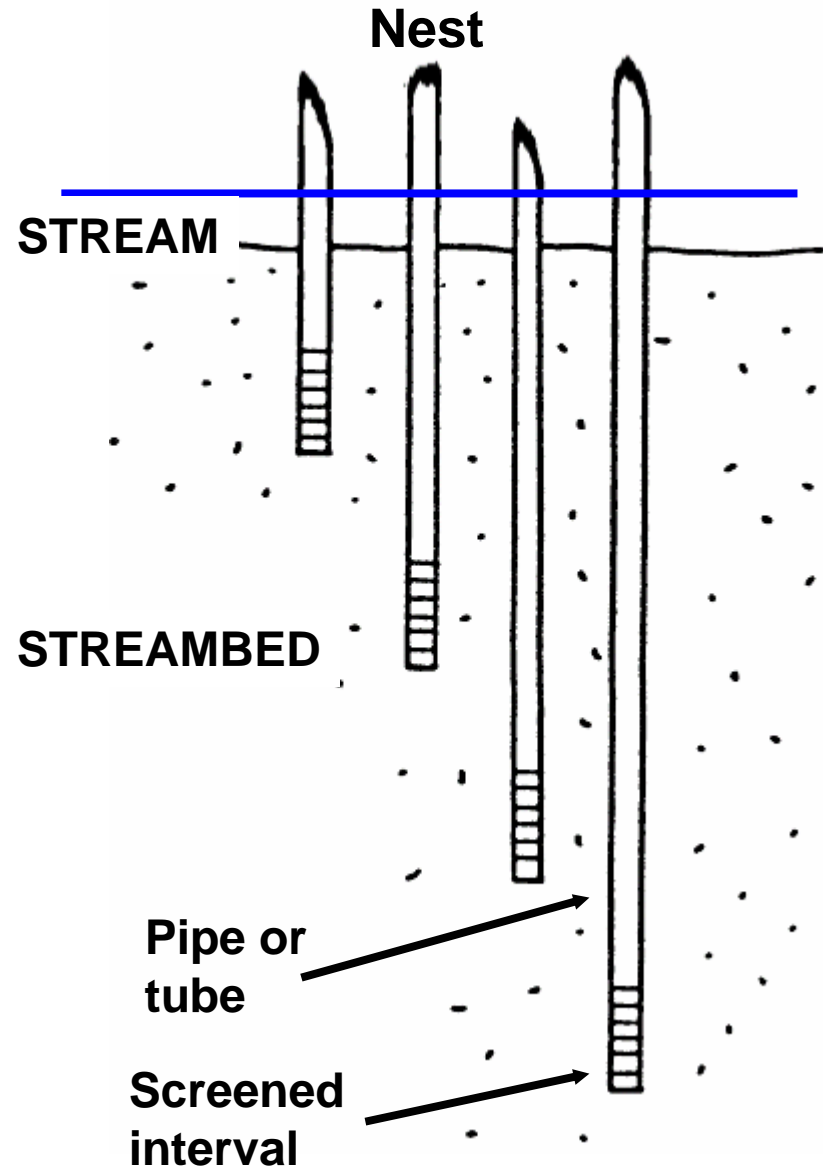


Photo from B. Conant Jr.



Photo from
M.S. Greenberg

Mini-piezometers

MHE Push-Point Sampler

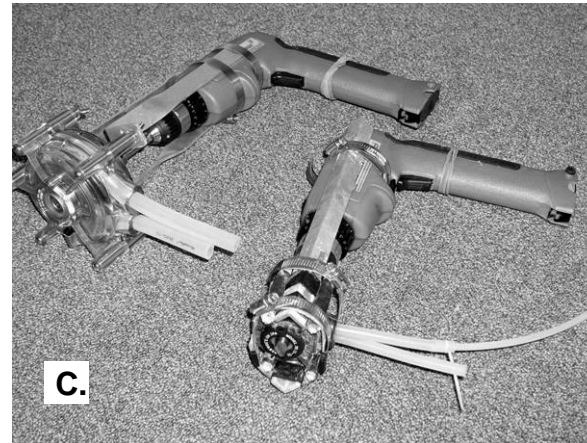
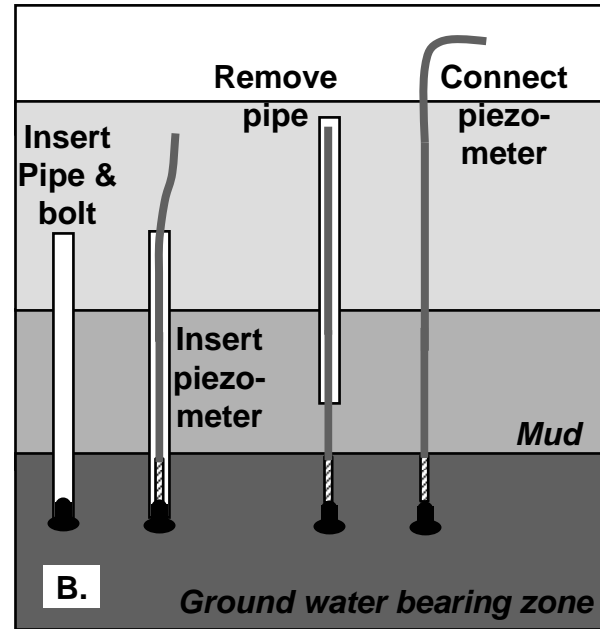
- 27-inch steel probe, 1.5-mL internal volume, screened zone at tip



See Henry (2000)
in EPA GW/SW Workshop Proceedings

Photos courtesy of Mark Henry

Minipiezometers – our design



Seepage Meters

Typical Seepage Meter

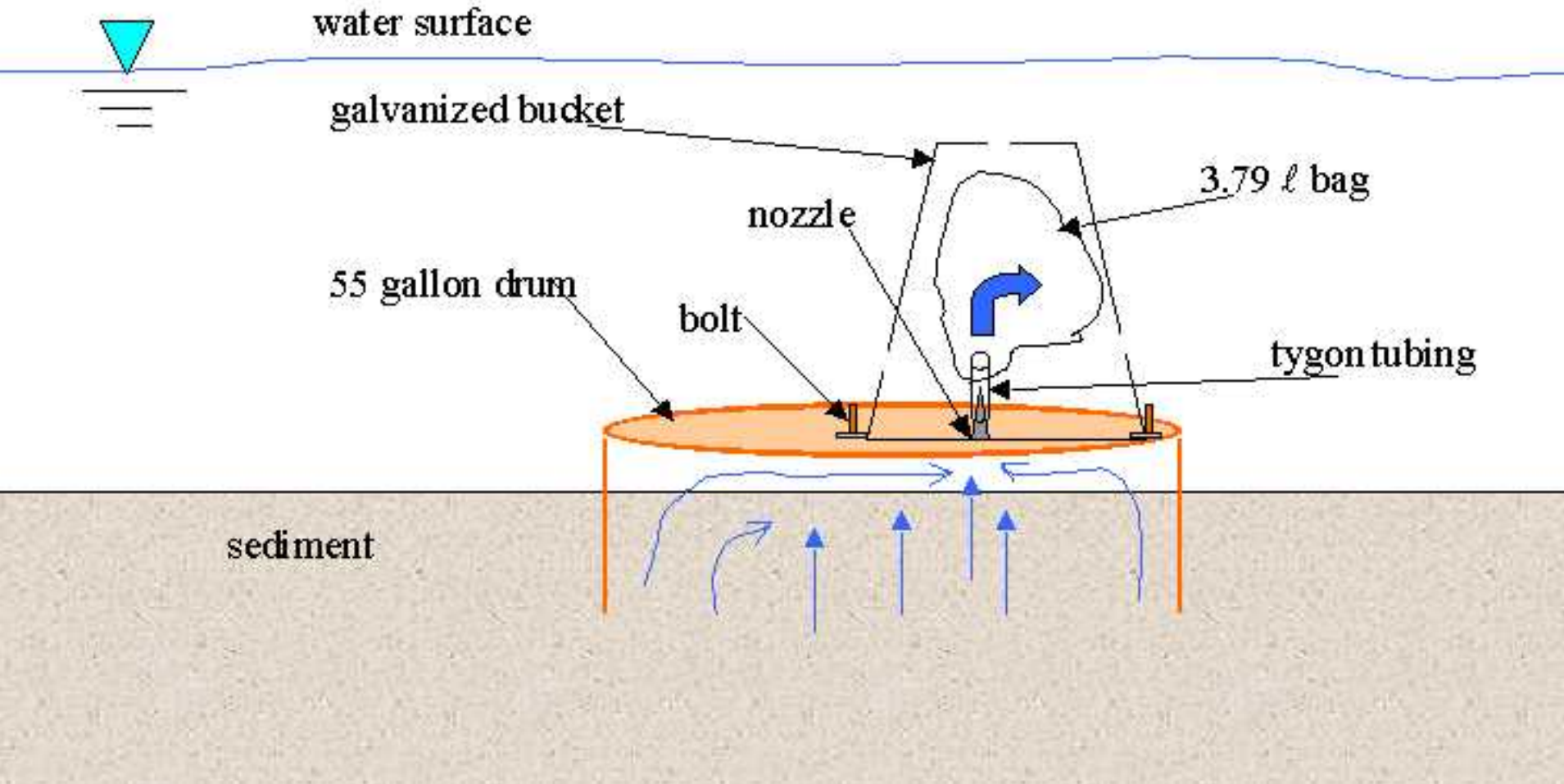


Diagram from O'Rourke et al. (2000).

Also see Lee and Cherry (1978)

Seepage Meter installed in a lake



Photos from USEPA Ground Water Forum 2000

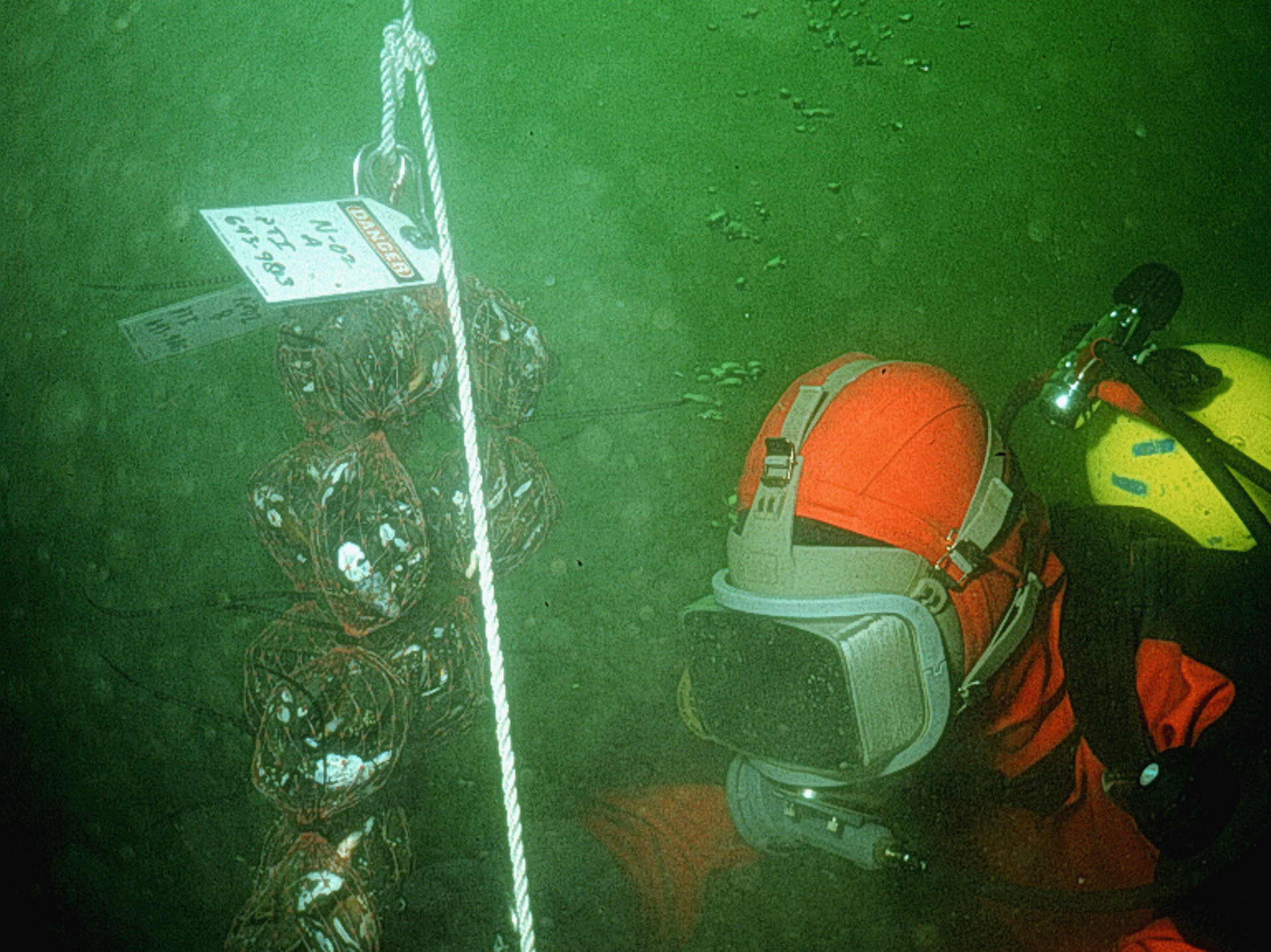
Seepage Meters: Our design

**Inverted and
trimmed 5 gal
bucket**

**~10.5" OD across
the base.**



Diffusion Samplers



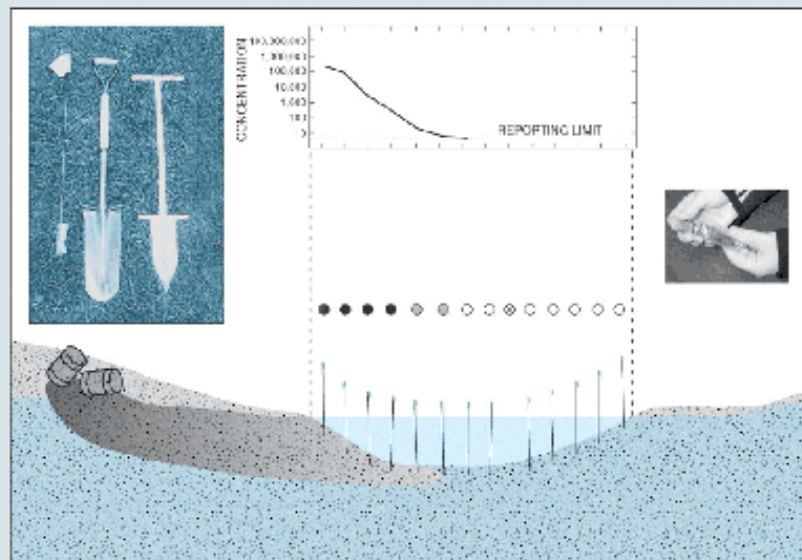
Diffusion Samplers

Build on existing designs



Guidance on the Use of Passive-Vapor-Diffusion Samplers to Detect Volatile Organic Compounds in Ground-Water-Discharge Areas, and Example Applications in New England

Water-Resources Investigations Report 02-4186



U.S. Department of the Interior
U.S. Geological Survey

Diffusion Sampler Installations

- For volatile organic compound sampling

See Vroblesky et al. (1991,1996)



A.



B.



C.

Photos courtesy of Peter Church (USGS)

Diffusion Samplers: Our design to collect volatile organic compounds

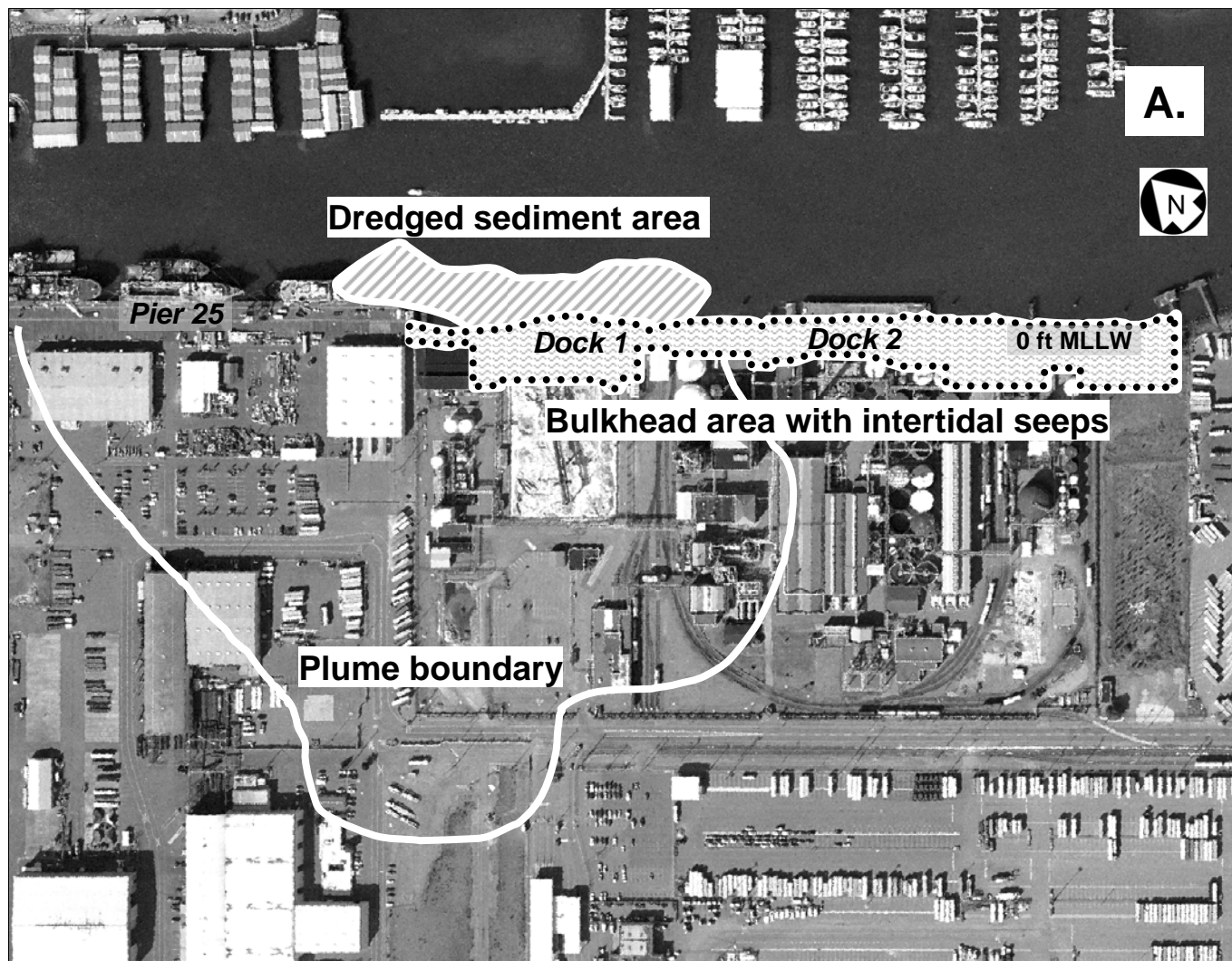


**Passive diffusion
sampler**

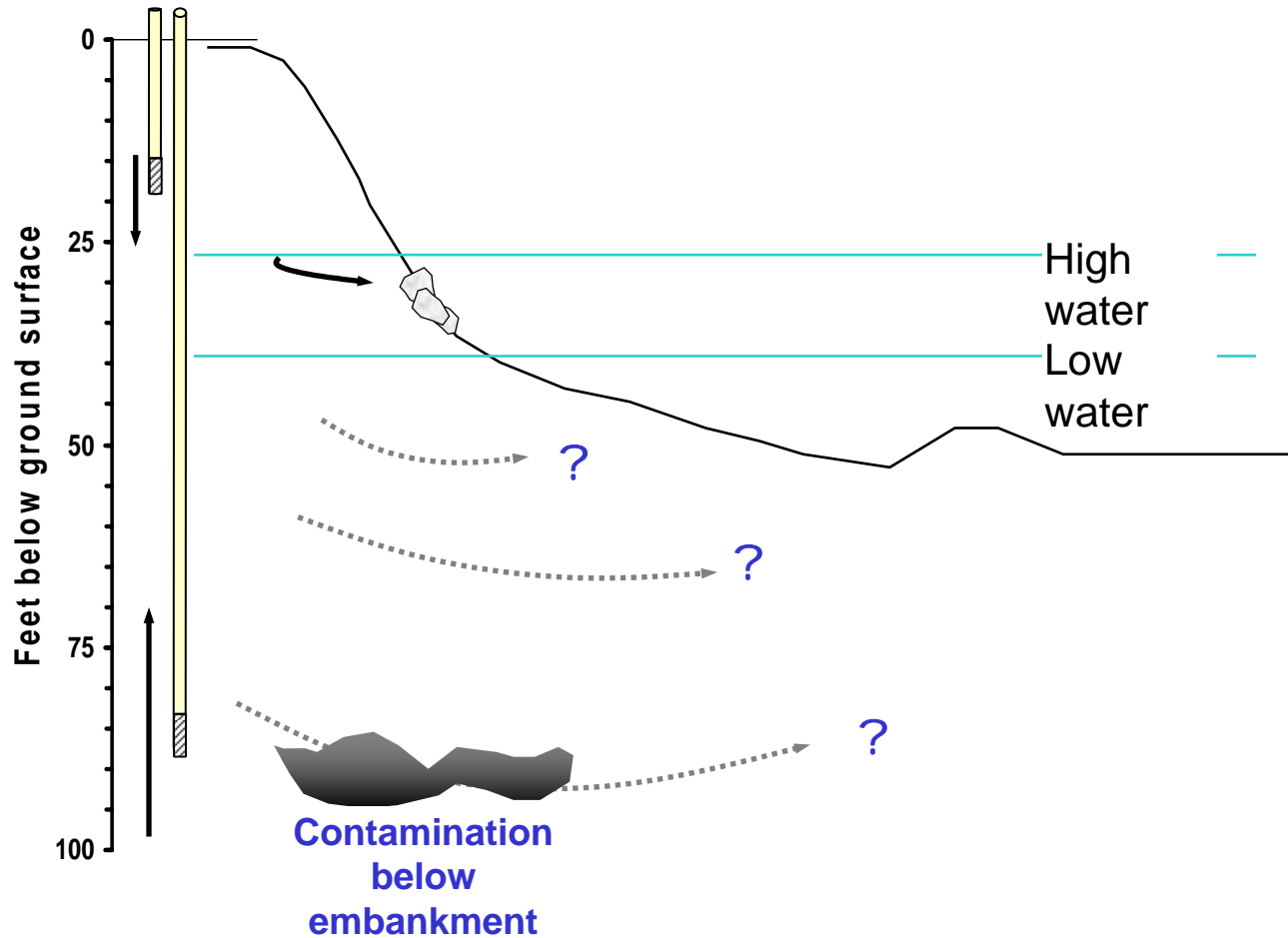
Chamber is 2.75" OD

Case Study

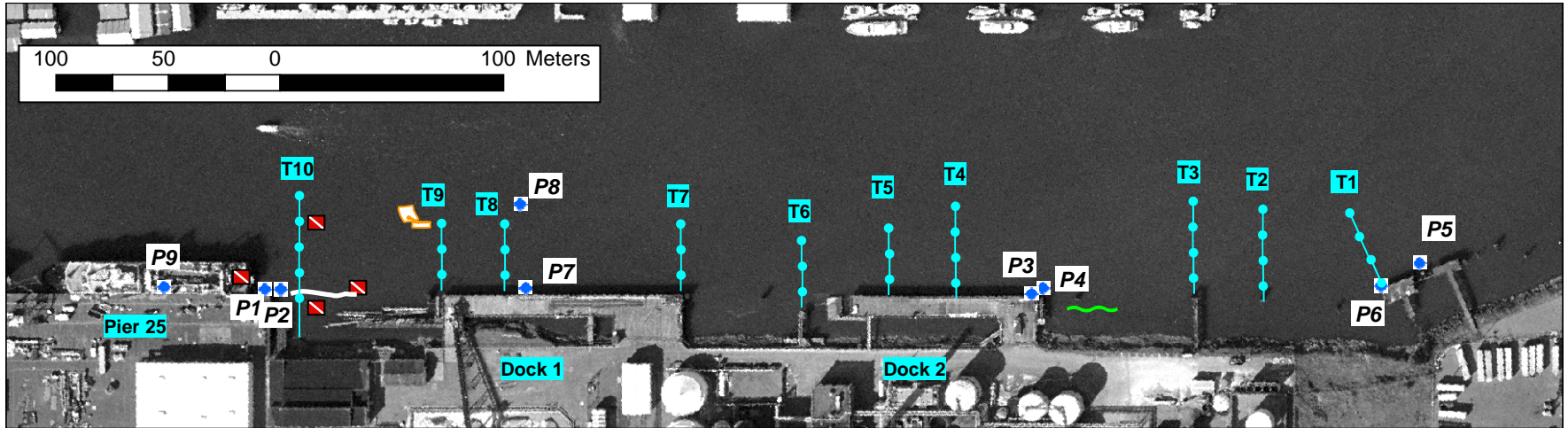
Introduction/setting – contaminants released on site and in waterway.



Initial conceptual model



Investigation moved subtidally based on intertidal seeps



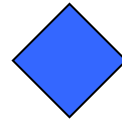
• Dive survey area



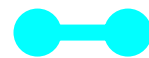
• Diver deployed hydrolab



• Video precipitates



• Minipiezometer



• Passive diffusion samplers



• Seepage meter

Measuring Water Levels

Discharge
(upwelling)

Figure 4. Manometer use



Photo from B. Conant Jr.

$$VHG = \frac{\Delta h}{\Delta l}$$

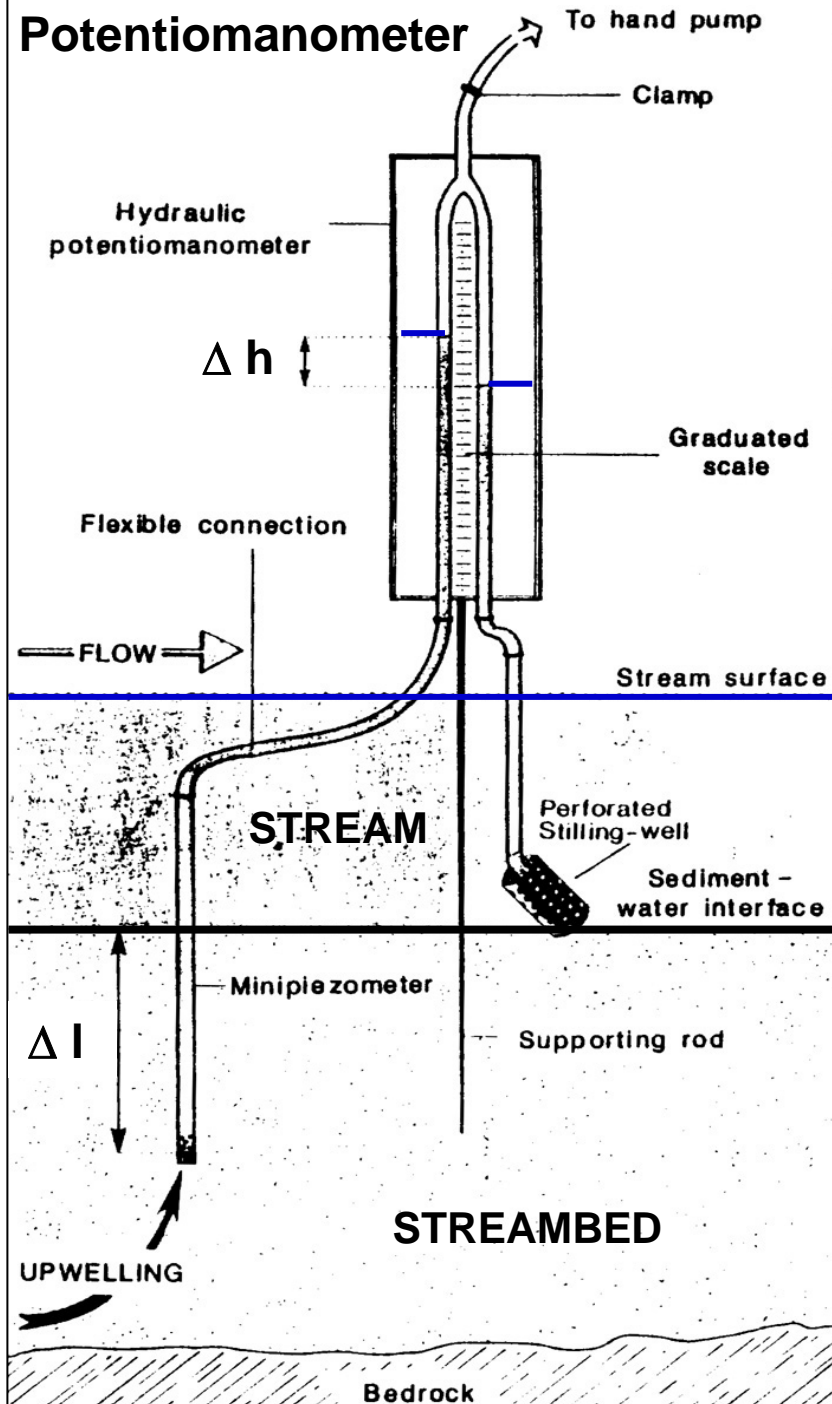
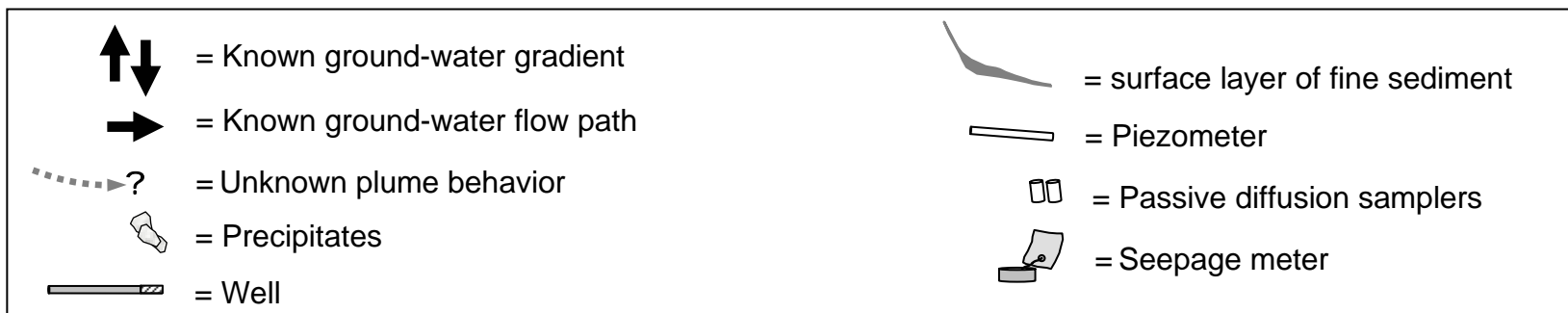
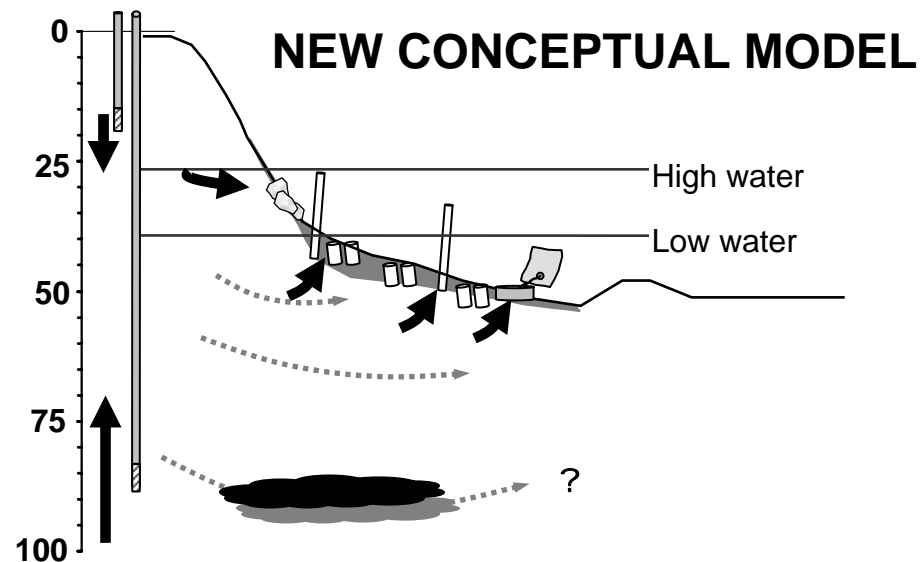
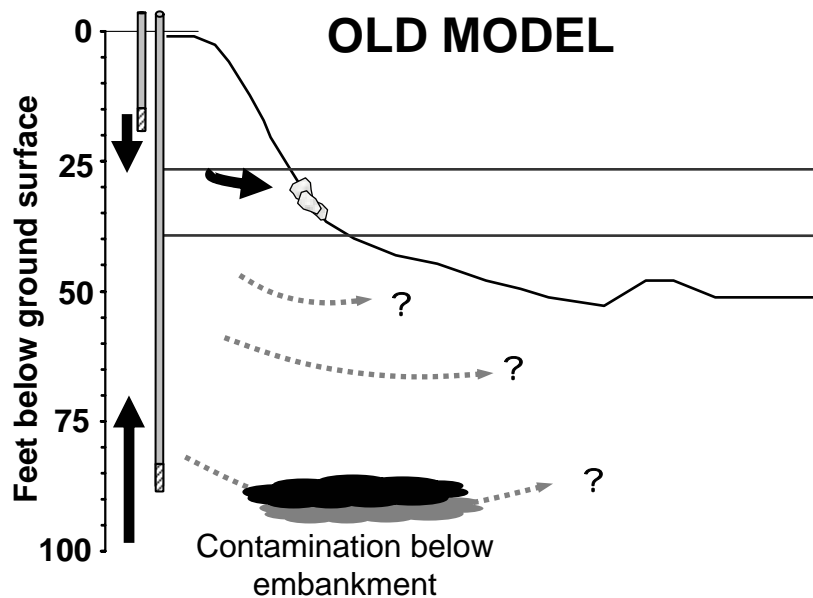
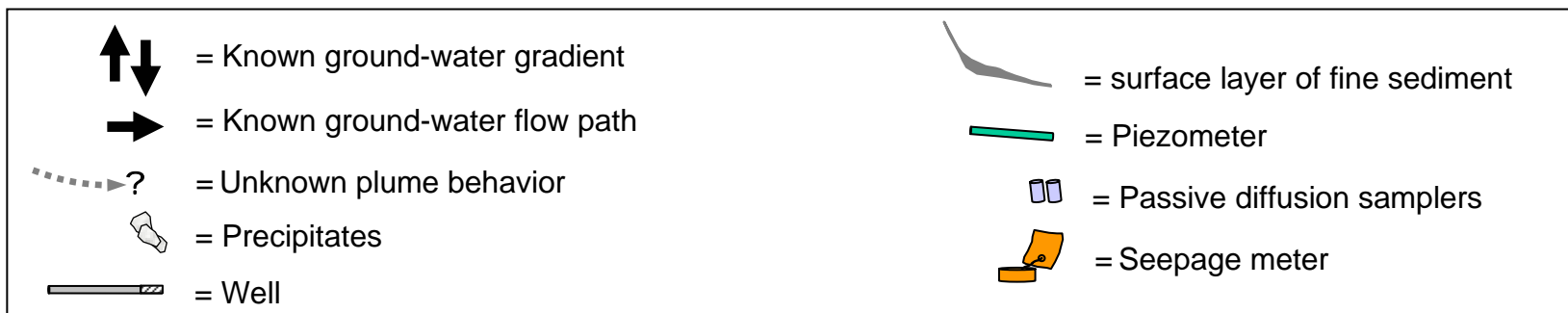
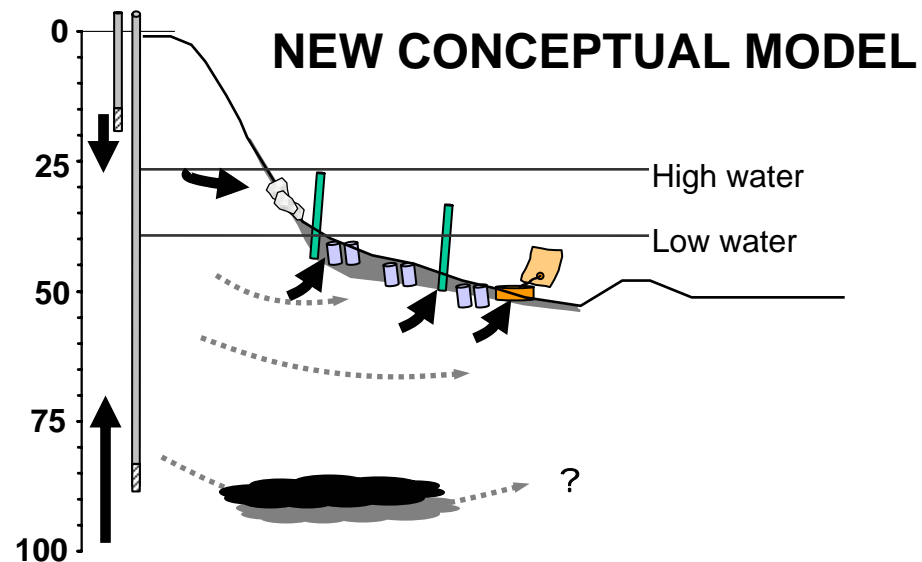
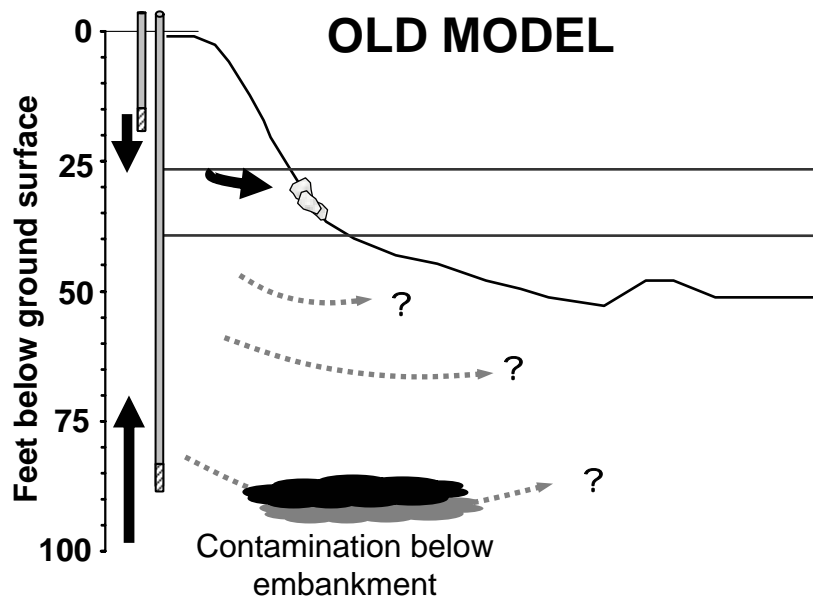


Figure from Boulton (1993)
Also see Winter et al. (1988)





Conclusion: Diver-deployed tools work well to evaluate ground water discharges to surface water



How To Contact the EPA Dive Team and For More Information

- *On the web*

<http://yosemite.epa.gov/R10/OEA.NSF/webpage/Dive+Team>

- *On the phone* 1-800-424-4372

- *Via email* pedersen.rob@epa.gov

- *Via snail mail*

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OEA-095, Seattle WA 98101





Serving Region
10 since 1968*